

(19) World Intellectual Property Organization  
International Bureau



(43) International Publication Date  
8 August 2002 (08.08.2002)

PCT

(10) International Publication Number  
**WO 02/061485 A3**

(51) International Patent Classification: **G02B 21/18**,  
21/16, 21/33, 21/10

36832-6766 (US). NEELY, William, Charles [US/US];  
415 Hare Avenue, Auburn, AL 36830-5409 (US).

(21) International Application Number: PCT/US01/46397

(74) Agents: ANDERSON, J., Scott et al.; Alston & Bird  
LLP, Bank of America Plaza, Suite 4000, 101 South Tryon  
Street, Charlotte, NC 28280-4000 (US).

(22) International Filing Date: 3 December 2001 (03.12.2001)

(25) Filing Language: English

(81) Designated States (*national*): AE, AG, AL, AM, AT, AU,  
AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU,  
CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH,  
GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC,  
LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW,  
MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU, SD, SE, SG,  
SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN,  
YU, ZA, ZM, ZW.

(26) Publication Language: English

(30) Priority Data:  
60/250,800 1 December 2000 (01.12.2000) US

(71) Applicant (*for all designated States except US*): AUBURN  
UNIVERSITY [US/US]; 309 Samford Hall, Auburn Uni-  
versity, AL 36849-5716 (US).

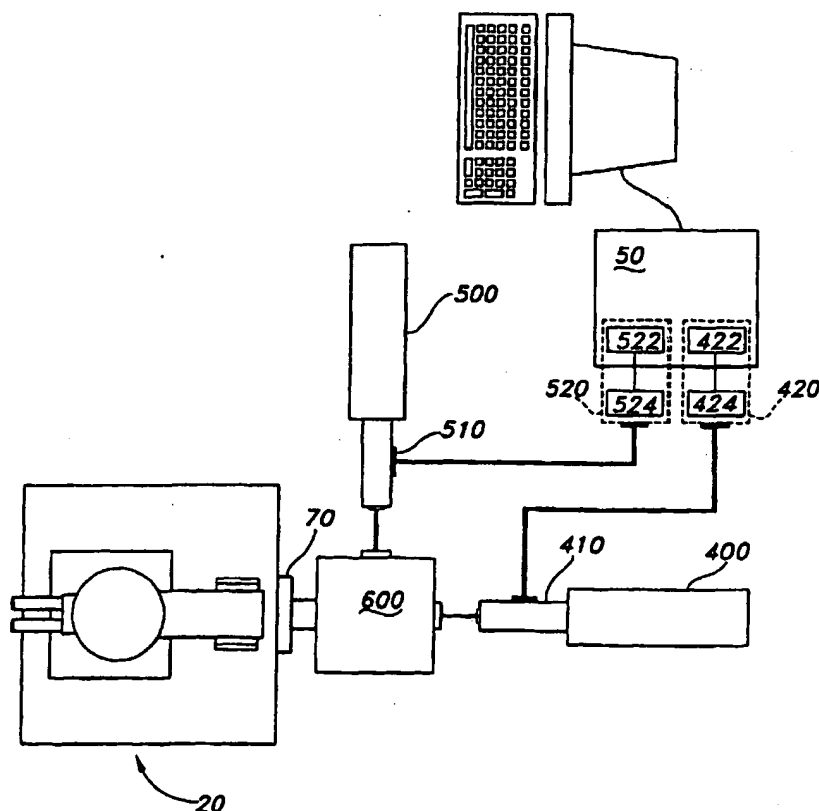
(84) Designated States (*regional*): ARIPO patent (GH, GM,  
KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW),  
Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM),  
European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR,  
GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent

(72) Inventors; and

(75) Inventors/Applicants (*for US only*): VODYANOV, Vi-  
taly, J. [US/US]; 541 Summertrees Drive, Auburn, AL

[Continued on next page]

(54) Title: HIGH-RESOLUTION OPTICAL MICROSCOPE



(57) Abstract: A direct-view optical microscope system is provided which uses high-energy light from a phenomenon known as non-resonant Raman scattering to illuminate a living biological specimen. One embodiment of the system combines two discrete light sources to form a combined incident light source for the microscope. The system includes a method and apparatus for modulating the intensity of the scattered light when two light waves are combined to produce the incident light. By varying the frequency of the two source light waves, the intensity of the combined Raman-scattered light can be modulated to achieve finer resolution.

WO 02/061485 A3



(BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR,  
NE, SN, TD, TG).

(88) Date of publication of the international search report:  
27 November 2003

**Published:**

— with international search report

*For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

## INTERNATIONAL SEARCH REPORT

Intern | Application No  
PCT/US 01/46397

## A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 G02B21/18 G02B21/16 G02B21/33 G02B21/10

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 G02B G01J

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, PAJ

## C: DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X  Y A	WO 98 45744 A (NORTHERN EDGE ASSOCIATES INC ; RICHARDSON TIMOTHY M (CA)) 15 October 1998 (1998-10-15)  abstract figures 1-4 page 5, line 19 -page 20, line 10 --- -/--	1-4, 6-8, 11-13  17-20 9, 10



Further documents are listed in the continuation of box C.



Patent family members are listed in annex.

## \* Special categories of cited documents :

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier document but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search

12 March 2003

Date of mailing of the international search report

02.04.03

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2  
NL - 2280 HV Rijswijk  
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,  
Fax: (+31-70) 340-3016

Authorized officer

Windecker, R

## INTERNATIONAL SEARCH REPORT

Intern Application No

PCT/US 01/46397

## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	<p>PATENT ABSTRACTS OF JAPAN vol. 1998, no. 03, 27 February 1998 (1998-02-27) -&amp; JP 09 297266 A (ISHIKAWAJIMA HARIMA HEAVY IND CO LTD; ISHIKAWAJIMA SYST TECHNOL KK), 18 November 1997 (1997-11-18) abstract -&amp; JP 09 297266 A (ISHIKAWAJIMA SYST TECHNOL KK) 18 November 1997 (1997-11-18) figures 1,2</p>	1,3,4, 6-8
Y	<p>US 4 737 022 A (FALTERMEIER BERND ET AL) 12 April 1988 (1988-04-12) abstract column 2, line 65 -column 4, line 15 figure 1</p>	1-8,11, 12
Y	<p>US 5 528 368 A (LEVIN IRA W ET AL) 18 June 1996 (1996-06-18) abstract figures 1,2,6,7 column 1, line 60 -column 2, line 60 column 7, line 3 -column 13, line 34</p>	1-8,11, 12
Y	<p>TOTZECK M ET AL: "PHASE-SHIFTING POLARIZATION INTERFEROMETRY FOR MICROSTRUCTURE LINEWIDTH MEASUREMENT" OPTICS LETTERS, OPTICAL SOCIETY OF AMERICA, WASHINGTON, US, vol. 24, no. 5, 1 March 1999 (1999-03-01), pages 294-296, XP000823521 ISSN: 0146-9592 page 294, left-hand column, last paragraph -right-hand column, paragraph 1 figure 1</p>	1-4,6-8, 11,12
Y	<p>GB 2 195 467 A (AIRE SCIENT LIMITED) 7 April 1988 (1988-04-07) figure 1 page 1, right-hand column, line 123 -page 2, left-hand column, line 4</p>	5
X	<p>US 5 841 577 A (NIU WEN-HUA ET AL) 24 November 1998 (1998-11-24)</p>	23-26
Y	<p>abstract figure 1 column 1, line 19 -column 6, line 29</p>	14-20, 22,31,32
	<p>--- -/-</p>	

## INTERNATIONAL SEARCH REPORT

 Intern      I Application No  
 PCT/US 01/46397

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WACHMAN E S ET AL: "IMAGING ACOUSTO-OPTIC TUNABLE FILTER WITH 0.35-MICROMETER SPATIAL RESOLUTION" APPLIED OPTICS, OPTICAL SOCIETY OF AMERICA, WASHINGTON, US, vol. 35, no. 25, 1 September 1996 (1996-09-01), pages 5220-5226, XP000628367 ISSN: 0003-6935	23-26
Y	abstract figure 3A page 5220, right-hand column, paragraph 3 -page 5221, left-hand column, paragraph 1 page 5222, left-hand column, paragraph 4 -page 5223, left-hand column, paragraph 3 -----	14-20, 22,31,32
X	US 4 405 237 A (MANUCCIA THOMAS J ET AL) 20 September 1983 (1983-09-20)	14
Y	abstract figures column 1, line 62 -column 4, line 37 -----	29
X	US 6 108 081 A (ZUMBUSCH ANDREAS ET AL) 22 August 2000 (2000-08-22)	27,28,30
Y		14-20, 22,29, 31,32
A	abstract figure 2 column 1, line 37 -column 8, line 53 -----	21

Form PCT/ISA/210 (continuation of second sheet) (July 1992)

page 3 of 3

# INTERNATIONAL SEARCH REPORT

ational application No.  
PCT/US 01/46397

## Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:  
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:  
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:
3. ☐ Claims Nos.:  
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

## Box II Observations where unity of invention is lacking (Continuation of Item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

As a result of the prior review under R. 40.2(e) PCT,  
no additional fees are to be refunded.

1. ☒ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☒ The additional search fees were accompanied by the applicant's protest.
- ☐ No protest accompanied the payment of additional search fees.

## FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. Claims: 1-13

A microscope for observing a specimen comprising a light source, an objective lens, a darkfield condenser, and a compound relay lens having two lenses, wherein the magnification of the first lens of the compound relay lens system is selected to be at least 40 times and the numerical aperture is at least 0.65.

2. Claims: 14-22,31,32

A microscope for observing a specimen comprising an objective lens, a darkfield condenser, and a compound relay lens having two lenses, wherein the illumination is selected to be composed by two light sources and two band-pass filters having different center wavelengths.

3. Claims: 23-26

A system for producing a first and a second light wave having different wavelengths, wherein the two light waves are produced from a single light source.

4. Claims: 27-30

A combiner having a chamber, a casing, and a prisma to combine two light waves, wherein the combiner also comprises a beam expander.

## INTERNATIONAL SEARCH REPORT

Inten Application No

PCT/US 01/46397

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
WO 9845744	A	15-10-1998	AU 7019798 A CA 2322800 A1 WO 9845744 A2 EP 0978008 A2	30-10-1998 15-10-1998 15-10-1998 09-02-2000
JP 09297266	A	18-11-1997	NONE	
US 4737022	A	12-04-1988	DE 3527322 A1 JP 62032411 A	12-02-1987 12-02-1987
US 5528368	A	18-06-1996	US 5377003 A US RE36529 E	27-12-1994 25-01-2000
GB 2195467	A	07-04-1988	NONE	
US 5841577	A	24-11-1998	AU 2128697 A DE 69714021 D1 DE 69714021 T2 EP 0883829 A1 IL 125586 A WO 9730371 A1	02-09-1997 22-08-2002 14-11-2002 16-12-1998 23-12-2001 21-08-1997
US 4405237	A	20-09-1983	NONE	
US 6108081	A	22-08-2000	CA 2338291 A1 EP 1099100 A1 JP 2002520612 T WO 0004352 A1	27-01-2000 16-05-2001 09-07-2002 27-01-2000